

Attorney Docket No. 82324
Customer No. 23523

ROTATING FEELER GAGE

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT (1) MARVIN W. CLEMENTS and (2) PAUL E. MOODY, citizens of the United States of America, employees of the United States Government, residents of (1) Portsmouth, County of Newport, State of Rhode Island, and (2) Barrington, County of Bristol, State of Rhode Island, have invented certain new and useful improvements entitled as set forth above of which the following is a specification:

MICHAEL P. STANLEY, ESQ.
Reg. No. 47108
Naval Undersea Warfare Center
Division, Newport
Newport, RI 02841-1708
TEL: 401-832-4736
FAX: 401-832-1231

1 Attorney Docket No. 82324

2

3

ROTATING FEELER GAGE

4

5

STATEMENT OF GOVERNMENT INTEREST

6

7

8

9

10

11

BACKGROUND OF THE INVENTION

12

(1) Field of the Invention

13

14

15

16

17

18

(2) Description of the Prior Art

19

20

21

22

23

24

25

26

27

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention generally relates to a gage. More particularly, the invention relates to a feeler gage, which can effectively and economically measure the gap between a watertight hatch and its seat, when the assembly is subjected to submergence pressure.

The current art for gages in connection with a submarines pressure hatch is normally designed with eight lugs, which extend beyond its gasket-sealing surface. The hatch is mated to a locking ring, which has similar lugs on its interior. When the locking ring is in one position, the hatch can open and close freely. However, if the locking ring rotates 22.5 degrees, the lugs on the locking ring cover the rings on the hatch and prevent it from opening. In addition, the locking ring itself is connected to its foundation by a threaded

1 connection. Therefore, when the locking ring rotates, its
2 moves axially. This results in the locking ring not only
3 blocking the possibility of the hatch opening but it also
4 pulls it firmly against its seat area. This is important to
5 effect a tight seal when the assembly is subjected to sea
6 pressure as well as holding the assembly securely, should it
7 be subjected to a shock load.

8 However, whenever a submarine hatch assembly is subjected
9 to submergence pressure it deflects in response to the loads
10 induced by the pressure. Accordingly, there is a problem in
11 the art wherein this deflection becomes greater as pressures
12 increase. In addition, there is the potential for this
13 deflection to actually lift the hatch off its gasket seat. If
14 this occurs there is the possibility of the gasket extruding
15 between the hatch and the seat area. If an excessive
16 deflection occurs the assembly may leak. If the gasket
17 extrudes between the hatch and its seat area then there is
18 also the potential to pinch the gasket as the pressure causing
19 component deflection, abates.

20 Therefore, it is very important to know how big a gap
21 will result from pressurization so that a proper gasket design
22 can be developed to match operating conditions. While this
23 information can be obtained analytically, there is a need to
24 validate the calculations prior to going to sea or
25 implementing a design fix to a fleet problem. Presently,
26 there is no method to measure the gap resulting from component
27 deflections. This disclosure reveals an economical and

1 effective method with the use of a feeler gage in order to
2 determine this gap under either a test or an operating
3 condition.

4 The following patents, for example, disclose various
5 types of hatch covers, but do not disclose the use of an
6 inexpensive feeler gage for determining a gap between a gasket
7 seat and a hatch.

8 Specifically, Schoonman (U.S. Patent No. 4,004,538)
9 discloses a wave responsive hatch cover locking and sealing
10 mechanism. In the mechanism, wave impact closes normally open
11 contacts on a marine vessel hatch cover face to initiate or to
12 increase fluid pressure within a collapsible hollow gasket
13 interposed at the interface between a hatch cover and a deck
14 hatchway to lock the hatch cover to the hatchway and to effect
15 a watertight seal therebetween.

16 Rodgers et al. (U.S. Patent No. 4,388,782) discloses a
17 grinder for preparing circular seats behind elliptical
18 handholes of marine boilers. An air motor, mounted within an
19 expandable housing, drives a grinding wheel against the inside
20 surface of the handhole. The housing is expanded to be
21 secured in the elliptical handhole. The center of the motor
22 orbits on a circle about the center of the housing so that a
23 circular seat is formed about the inside edge of the
24 elliptical handhole.

25 Leung (U.S. Patent No. 4,466,551) discloses a releasable
26 closure device adapted to provide sealing engagement between
27 abutting surfaces by means of a rotatable locking ring

1 comprising a plurality of locking lugs adapted to frictionally
2 engage recessed locking channels disposed in the surfaces.

3 Wilger et al. (U.S. Patent No. 4,534,135) discloses a
4 machine provided for in-situ grinding of tapered lugs on a
5 hatch, such as a hatch aboard a submarine. A base is provided
6 and a device is attached to alternate lugs of the hatch for
7 mounting the base across the hatch opening. An elongated
8 plate is mounted at its center to the base for pivotal
9 movement thereon. The pivotal plate has opposite ends wherein
10 each end is extendable between a pair of alternate lugs, one
11 of the lugs between one of the pair of lugs being a lug to be
12 ground. A device is mounted on the base for oscillating the
13 pivotal plate back and forth between the lugs of each pair of
14 alternate lugs. A grinder is provided, and a device is
15 utilized for mounting the grinder at one end of the pivotal
16 plate for selectively engaging the grinder with or backing the
17 grinder away from the lug to be ground. With this arrangement
18 a lug can be ground by oscillating the pivotal plate and
19 engaging the grinding means with the lug.

20 Duarte et al. (U.S. Patent No. 5,562,065) discloses an
21 elastomeric pump including a rigid outer housing defining an
22 outer chamber and having a fluid inlet thereinto. The pump
23 further includes an inner housing disposed within the outer
24 housing. The inner housing is provided with rigid walls and
25 first and second expandable members, the first expandable
26 member having greater elasticity than the second expandable
27 member, the rigid walls and expandable members defining an

1 inner chamber. A fluid conduit extends from the inner chamber
2 to the exterior of the outer housing. A rigid cage is fixed
3 to the inner housing and is disposed over the first expandable
4 member, and is configured to permit and limit expansion of the
5 first expandable member.

6 It should be understood that the present invention would
7 in fact enhance the functionality of the above patents by
8 providing a feeler gage selectively inserted into an opening
9 formed between a gasket seat and a seating surface of a hatch
10 in a hatch-locking ring assembly as illustrated in the
11 preferred embodiment of the present invention.

12

13

SUMMARY OF THE INVENTION

14 Accordingly, it is a general purpose and primary object of
15 the present invention to provide a gap-measuring gage.

16 It is a further object of the present invention to
17 provide a gap-measuring gage for increasing a gap that is not
18 accessible for direct insertion of a feeler gage.

19 It is a still further object of the present invention to
20 provide a gap-measuring gage for a hatch-locking ring
21 assembly.

22 It is a still further object of the present invention to
23 provide a feeler gage for a hatch-locking ring assembly in
24 which the feeler gage is inserted into a gap formed between a
25 gasket seat and a hatch of the assembly.

26 It is a still further object of the present invention to
27 provide a feeler gage for a hatch-locking ring assembly in

1 which the feeler gage can detect the presence or absence of a
2 gap in seal of the assembly.

3 It is a still further object of the present invention to
4 provide a feeler gage for a hatch-locking ring assembly in
5 which the feeler gage can detect the presence or absence of a
6 gap between a gasket seat and a hatch portion of the assembly.

7 To obtain the objects described, there is provided a
8 feeler gage including a pin member having a first end and an
9 opposing end with a gage connected to the opposing end of the
10 pin member. The gage has a first end connected to the pin and
11 a free end projecting past a peripheral dimension of the pin.
12 An indicator is formed on the first end of the pin member in
13 alignment with a longitudinal axis of the gage for determining
14 a position of the gage upon rotation of the pin member. The
15 gage is of a predetermined thickness and is aligned with the
16 indicator formed at the first end of the pin member. Rotation
17 of the pin member correspondingly rotates the gage of the pin
18 member. If the gage rotates freely, then a gap is determined
19 to be present in the area where the gage is rotated through.
20 If the gage does not rotate freely, then no gap exists.

21

22 BRIEF DESCRIPTION OF THE DRAWINGS

23 The appended claims particularly point out and distinctly
24 claim the subject matter of this invention. The various
25 objects, advantages and novel features of this invention will
26 be more fully apparent from a reading of the following
27 detailed description in conjunction with the accompanying

1 drawings in which like reference numerals refer to like parts,
2 and in which:

3 FIG. 1 is a top plan view of a typical hatch and hatch-
4 locking ring assembly known in the art;

5 FIG. 2 is a sectional view of the hatch in FIG. 1;

6 FIG. 3 is a sectional view of a typical hatch and hatch-
7 locking ring assembly in an unlocked position with the view
8 taken along line 3-3 of FIG. 1;

9 FIG. 4 is a sectional view of a typical hatch and hatch-
10 locking ring assembly in an unlocked position with the view
11 taken along line 4-4 of FIG. 1;

12 FIG. 5 is a sectional view of a typical hatch and hatch-
13 locking ring assembly in a locked position with the view taken
14 along line 5-5 of FIG. 1;

15 FIG. 6 is a sectional view of a typical hatch and hatch-
16 locking ring assembly in a locked position with the view taken
17 along line 6-6 of FIG. 1;

18 FIG. 7 is a side view of the feeler gage of the present
19 invention;

20 FIG. 8 is a top view of the feeler gage of the present
21 invention with the view taken along line 8-8 of FIG. 7;

22 FIG. 9 is a sectional view of the feeler gage of the
23 present invention inserted into the hatch-locking arrangement
24 assembly of FIG. 5; and

25 FIG. 10 is a sectional view of a rotated feeler gage of
26 the present invention inserted into the hatch-locking ring
27 arrangement of FIG. 5.

28

1 **DESCRIPTION OF THE PREFERRED EMBODIMENT**

2 In general, the present invention is directed to a gage,
3 and more particularly to a feeler gage for measuring a gap
4 between a watertight hatch and its seat, when a hatch-locking
5 ring assembly is subjected to submergence pressure.

6 Turning now to the drawings, wherein like numerals refer
7 to like elements throughout the several views, FIG. 1 reflects
8 a typical hatch-locking ring arrangement. While the subject
9 matter shown here in FIGS. 1 through 6 illustrating the
10 configuration of a hatch-locking ring arrangement is correctly
11 characterized as Prior Art, the description thereof will be
12 included in connection with the detailed description of the
13 preferred embodiment, since the invention operates in
14 connection with this particular type of hatch-locking ring
15 arrangement.

16 Accordingly, FIG. 1 generally illustrates a hatch 10 and
17 a locking ring 12. The hatch 10 includes a plurality of lugs
18 14 protruding at intervals therefrom around an outer
19 circumference 16 of the hatch 10. The interval nature of the
20 lugs 14 correspondingly define recessed notches therebetween
21 around the outer circumference 16 of the hatch 10.

22 The locking ring 12 includes a plurality of protruding
23 lugs 26 spaced around an inner circumference 28 thereof.
24 Likewise, a plurality of recessed notches 30 are interspaced
25 between the plurality of protruding lugs 26. The plurality of
26 hatch lugs 14 correspond in spacing to that of the plurality
27 of locking ring lugs 26.

1 The right side of FIG. 1 depicts the locking ring 12
2 rotated such that it captures the lugs 14 of the hatch 10.
3 The left side of FIG. 1 depicts how the lugs 14 of the hatch
4 10 fit within the recessed notches 30 of the locking ring 12
5 prior to its rotation.

6 When the hatch 10 is viewed as a section in FIG. 2, a
7 gasket groove 20 is seen in primary ring 21 and a seating
8 surface 22 of the hatch 10 with the body portion of the hatch
9 shown as an elliptical head portion 24. The purpose of the
10 gasket groove 20 is to retain a sealing gasket, and with the
11 elliptical head portion 24 being a pressure containing dished
12 configuration.

13 Each of FIGS. 3, 4, 5, and 6 depict additional detail of
14 the hatch-locking ring arrangement and features which
15 contribute to sealing of the hatch-locking ring arrangement.
16 In particular, there is provided a gasket 32 having a surface
17 34 against which the hatch 10 seals. The surface 34 includes
18 a peripheral groove 36 for receiving a corresponding lip 38 of
19 the locking ring 12. FIGS. 3 and 4 depict the configuration
20 reflected by the left side of FIG. 1 (the unlocked position of
21 the hatch-locking ring arrangement); while FIGS. 5 and 6
22 reflect the configuration on the right side of FIG. 1 (the
23 locked position of the hatch-locking ring arrangement).

24 FIG. 3 depicts the area where one of the plurality of the
25 lugs 14 of the hatch 10 are free to lift out of the locking
26 ring 12. FIG. 4 depicts the area where the locking ring lug
27 26 exists, however there is no hatch lug 14 to be entrapped.

1 FIG. 5 illustrates that once the locking ring 12 is
2 rotated to the locked position, the area 56 where both hatch
3 10 and locking ring 12 have no lugs 14 or 26 that match each
4 other while FIG. 6 illustrates that in this position, the
5 hatch lug 14 engages with the locking ring lug 26 at 58 to
6 prevent lifting the seating surface 22 of the hatch 10 from
7 its seated position against the surface 34 of the gasket 32.

8 FIGS. 7 and 8 depict the feeler gage 40 of the present
9 invention in detail. As shown in FIGS. 7 and 8 the feeler
10 gage 40 includes a pin 42 having a first end 44 and an
11 opposite end 46. The pin 42 includes a knurled or gripping
12 portion 45 adjacent the first end 44 thereof. A scribe mark
13 48 is formed in the first end 44 of the pin 42 and a tapped
14 hole 50 is formed in the opposite end 46 of the pin 42. A
15 gaging protrusion 52 is connected to the opposite end 46 of
16 the pin 42 by an attachment screw 54 or similar securement
17 member into the tapped hole 50.

18 The gaging protrusion 52 of the feeler gage 40 is of a
19 length greater than the diameter of the pin 42 so that a
20 portion of the gaging protrusion 52 is visible from the top
21 view of the pin 42 as shown in FIG. 8. The gaging protrusion
22 52 can be of varying thicknesses and lengths determined
23 according to a given use.

24 As indicated, the gaging protrusion 52 is attached to the
25 tapped end 46 of the pin 42 so that the longitudinal axis of
26 the gaging protrusion 52 lines up with the scribe mark 48.

1 FIG. 9 shows that the gaging protrusion 52 can be pre-
2 rotated to maneuver in the gap 60 between the hatch 10 and the
3 locking ring 12 in the area where the lugs 14, 26 do not
4 exist. Both FIG. 9 and FIG. 10 correlate to FIG. 5 where the
5 hatch-locking ring arrangement is in its closed position.

6 Referring again to FIG. 4 it can be seen that it would
7 not be possible to rotate the feeler gage once in the gap 60
8 as the gaging protrusion 52 could not slide between the
9 seating surface 22 and the surface 34. However, as components
10 of the hatch-locking ring arrangement start to deflect, a gap
11 61 will occur as illustrated by FIG. 10. It is then possible
12 to rotate the feeler gage and its gage member 52 by engaging
13 the gripping portion 45 and turning the pin 42. By trial and
14 error based on an arc of rotation 70 of the gaging protrusion
15 52, to a rotating end point 72, a deflection of the gap 61
16 between the hatch 10 and locking ring 12 is measurable. A
17 test pressure based upon predetermined factors is correlated
18 with the thickness of the gaging protrusion 52 fit between the
19 surface 34 and the seating surface 22 of the hatch 10.

20 If the gap 61 becomes so large that the gasket within
21 groove 20 extrudes into it, (therefore blocking rotation of
22 the gaging protrusion 52 of the pin 42) then a special
23 purpose, higher durometer gasket may be used to prevent
24 extrusion, while a test is being conducted.

25 In addition, the gaging protrusion 52 is connected to the
26 pin 42 so that it mechanically aligns with the scribe mark 48.
27 It is anticipated that a number of pins will be manufactured

1 and marked with a permanently attached gage thickness.
2 Therefore, a set of gages could be used to determine gap
3 spacing without the necessity of attaching and replacing
4 various thickness gages on the same pin. This is a viable
5 option due to the low cost associated with pin manufacture.

6 In operation, the pin 42 having the gage protrusion 52
7 thereon is rotated so as to be placed in the gap 60 formed
8 between the locking ring 12 and the hatch 10. When there are
9 pressure fluctuations affecting the hatch-locking ring
10 arrangement, the pin 42 is turned so that the gage protrusion
11 52 passes between the surface 34 and the seating surface 22 of
12 the hatch 10. If the thickness of the gage portion 52 is such
13 that it can pass between the gasket seat 34 and the seating
14 surface 22 of the hatch 10, determinations such as pressure
15 fluctuations are deduced according to the thickness of the
16 gage portion 52 being used.

17 This invention has been disclosed in terms of certain
18 embodiments. It will be apparent that many modifications can
19 be made to the disclosed apparatus without departing from the
20 invention. Therefore, it is the intent of the appended claims
21 to cover all such variations and modifications as come within
22 the true spirit and scope of this invention.